HOW DO YOU MONITOR AN ECOSYSTEM?—CSESP STUDIES IN 2008–2014

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BACKGROUND

There is great interest in offshore oil and gas development in the northeastern Chukchi Sea, off of northwestern Alaska. Because of this interest, there is a need for recent information on the oceanography and ecology of the region, both new information and information needed to update historical data sets. This information can help to provide a better understanding of the ecology of the area and to provide perspective on long-term environmental change that may have happened, or be happening, in the area.

To help to provide this information, we began in 2008 the Chukchi Sea Environmental Studies Program (CSESP), an integrated interdisciplinary, ecosystem-level approach to studying the environment in this area that was jointly funded by ConocoPhillips, Shell, and Statoil. This program recently completed its seventh consecutive year of studies (2008–2014).

Our first understanding of the ecology of this region was published in 10 papers in a Special Issue (Volume 67) of *Continental Shelf Research* (published in fall 2013). We are working on a second set of publications that will encompass the first 6 years of the study and evaluate a new monitoring approach for this region that began in 2014.

CSESP 2008–2013

OCEANOGRAPHIC STATIONS

In 2008–2010, we sampled three study-area boxes in the northeastern Chukchi Sea known as Klondike, Burger, and Statoil (Figure 1). In 2011–2012, we expanded the study area to include most of Hanna Shoal (called the Greater Hanna Shoal Study Area) to learn more about how our smaller study areas fit into the broader region. In 2013, we reoriented to the study-area boxes and added the DBO (Distributed Biological Observatory) line, which ran from the nearshore zone to the Central Channel. In 2014, we sampled 6 lines of stations, including 40 stations we had been sampling; we believe that this new approach will enable the detection of long-term ecological change over the region.

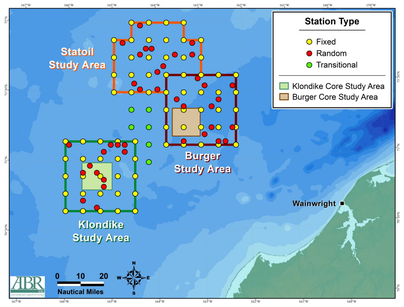
BIRD/MAMMAL SURVEYS

Bird and mammal surveys followed the general approach for stations, with the focus on study-area boxes in 2008–2010, the Greater Hanna Shoal study area in 2011–2012, and the reorientation to study-area boxes and the DBO line in 2013 (Figure 2). In 2014, we sampled both the lines on which oceanographic stations lay and parallel lines 3 NM (~5.5 km) away from the oceanographic lines.

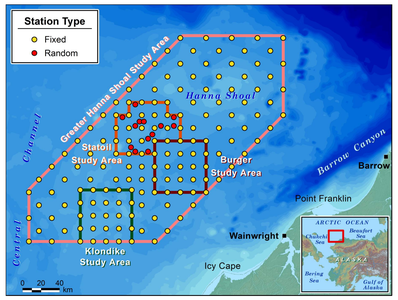
ACOUSTIC MOORINGS

Acoustic surveys consisted of a series of 25–30 mooring locations throughout the study area that were sampled continuously or nearly continuously throughout the entire study (Figure 3). Moorings consisted of either single-sensor acoustic recorders or multi-recorder mooring arrays. Most of the 22 single-sensor moorings were used only during the summer, whereas a subset of 8–10 moorings was maintained year-round. Three mooring arrays of 5–12 recorders each were used to localize marine-mammal calls in and near areas within the study-area boxes that were of greatest interest in oil and gas development. All recorders were calibrated so that absolute noise levels and marine-mammal call amplitudes could be measured.

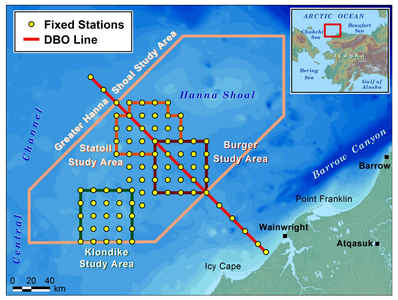
FIG 1. OCEANOGRAPHIC SAMPLING DESIGN



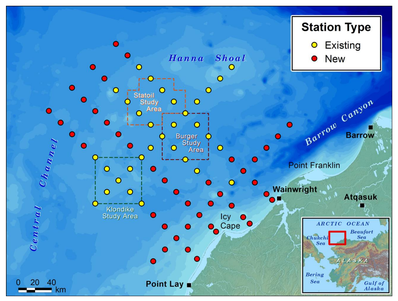
2008–2010



2011–2012

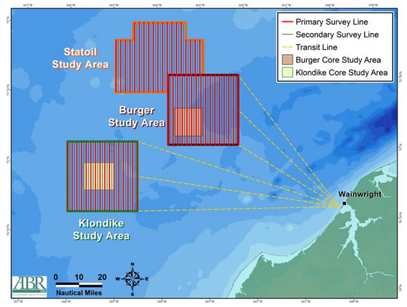


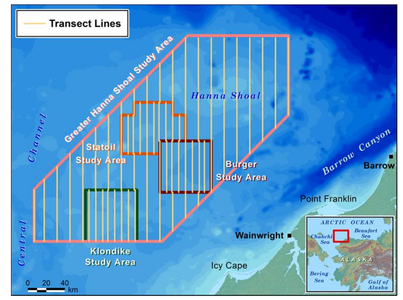
2013

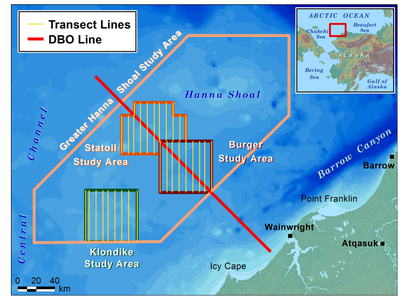


2014

FIG 2. BIRD/MAMMAL SAMPLING DESIGN







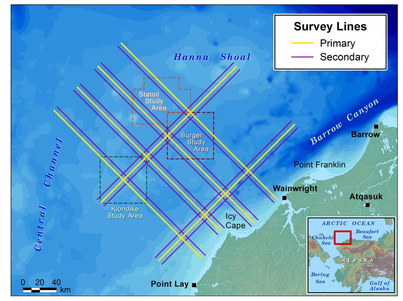
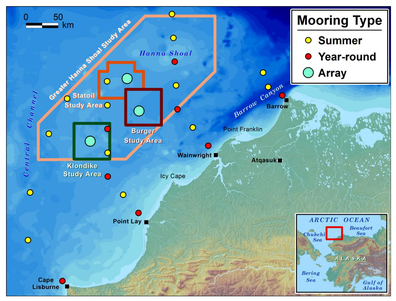


FIG 3. MARINE-ACOUSTICS SAMPLING DESIGN



NEW APPROACH IN 2014

- Provides a lower-intensity sampling of the northeastern Chukchi Sea than we have used in previous years but forms a good framework for monitoring the system.
- Includes both nearshore and offshore waters as indicators of change and samples important areas (e.g., Ledyard Bay Critical Habitat Unit, Hannah Shoal Walrus Use Area).
- In the offshore area, also samples distinct water-masses (e.g., Bering Sea Water, Winter Water, Meltwater), each of which has specific attributes.
- The 4 sampling lines orthogonal to the coastline also enable comparisons to be made across nearshore (Alaska Coastal Water) and offshore (Bering Sea, Meltwater, Winter Water) water-masses.

DISCUSSION & CONCLUSIONS

We believe that this sampling approach has helped us in the CSESP Program to discover much about the ecology of the northeastern Chukchi Sea. The overall sampling approach has been intensive (closely spaced stations and survey lines, 2-3 cruises/year, 7 consecutive years of sampling) and extensive (3 study-area boxes, Greater Hannah Shoal Study Area, DBO line, new broad-scale sampling).

The approach implemented in 2014 builds on several strengths of the CSESP Program.

- Incorporates 40 stations that we had sampled previously; some of these stations had been sampled up to 3 times/year for up to 6 years prior to 2014; this incorporation of many existing stations increases the possibility of detecting long-term ecological change.
- Samples 2 seasons/year for most of the disciplines; we have found that only 1 sample/year does not enable a full understanding of the progression of the communities over the open-water period.
- Continues the consecutive nature of the sampling over 7 consecutive years.
- Enables monitoring of both the nearshore and offshore communities over a broad part of Hanna Shoal. We are just beginning to document and study the nearshore community but have a much better understanding of the offshore communities at this point.

ACKNOWLEDGMENTS

Funding for this study has been provided by ConocoPhillips Company, Shell Exploration and Production Company, and Statoil USA E&P, Inc. Olgoonik Fairweather LLC provided overall project management and coordination and somehow herded all of these cats in the same direction. Aldrich Offshore Services provided ships and support personnel, and Olgoonik Oilfield Services provided logistical support at Wainwright. We thank all of the captains, crews, marine techs, medics, HSE personnel, scientific teams, and Iñupiaq communicators who came together and safely conducted some great science in an extremely remote part of Alaska.